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CERTAIN PROPERTIES OF THE ATMOSPHERE OF JUPITER ACCORDING TO SPECTROPHOTOMETRIC OBSERVATIONS

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CERTAIN PROPERTIES OF THE ATMOSPHERE OF JUPITER ACCORDING TO SPECTROPHOTOMETRIC OBSERVATIONS

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ABSTRACT. The results of spectrophotometric observations of Jupiter are discussed which were accomplished in 1962 and 1963 at the Crimean Astrophysics Observatory. Measurements were made in the 4,350 to 3,400 Å band to determine variations in the width of the spectra of Jupiter. Measurements were made at both the North and South Poles and are presented in tabulated form.

In the atmosphere of Jupiter rapid and intensive changes in the nature of /42* the visible formations on the planetary disk are observed. Naturally the question arises regarding how these changes affect the state of the Jovian atmosphere as a whole and the nature of its structure in various parts of the planet. From time to time changes in the atmosphere of Jupiter are unique. In this connection the study of the meteorology of Jupiter presents considerable interest. This study may be conducted by means of an investigation of changes across the planetary disk with time by means of spectroscopy of sufficiently high dispersion.

In October, 1962 in order to investigate possible spectral differences along the Jovian disk, planetary spectra were obtained with different positions of the slit of the spectrograph: along the equatorial diameter, along the polar diameter, and in the region of the North and South Poles parallel to the equator.

In a visual examination of spectra it is possible to detect a certain difference with wavelength in the behavior of the widths of spectra obtained during the position of the slit along the polar diameter and along the equator. In order to verify this circumstance the spectra were measured photometrically.[1]

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[1] Galkin, L. S., *Izv. Krymskoy Astrofizicheskoy Observatorii*, Vol. 32, No. 11, 1964.

* Numbers in the margin indicate pagination in the foreign text.

Observations were conducted on the quartz spectrograph of the 1,220 mm reflector telescope of the Crimean Astrophysical Observatory. In all approximately 60 spectrograms of Jupiter were obtained and processed. Planetary spectra were obtained on different dates under identical conditions:

1. The width of the spectrograph slit was always 0.1 mm;

2. One cycle of observations lasted for approximately 10-15 minutes and never exceeded 20 minutes.

3. High requirements were imposed for conditions of observation (the quality of the image was good and vibration was insignificant; the observations were conducted during the night with good transmittance).

In order to obtain the spectra Type 103 a - O film of the Eastman Kodak Company was used, and the developer was D-19.

The spectra were scanned photometrically on the MF-4 microphotometer across the dispersion. The usual blackened curves were transformed into intensity curves. The change in the characteristic curve with wavelength was taken into consideration. Then the widths of these photometric curves, i.e., the spectral widths for different wavelengths, were measured at the same intensity. Selected were 23 wavelength sections (in the range from 4,350 to 3,400 Å). /44

The conditions under which the spectra were obtained and their processing were completely identical and therefore it was possible to compare the behavior of the change in the widths of spectrograms for the equatorial and polar sections for all observation dates: October 26, 1962; August 15, November 15, and November 17, 1963.

In Figure 1 wavelength is shown on the abscissa and the ordinate shows average values relative to the change in spectral widths in units of width for λ 4,300 A on different days of observations in 1962 and 1963.

It should be noted that phase could not influence curve behavior for the equatorial section since phase correction for these dates did not exceed 0°.5.

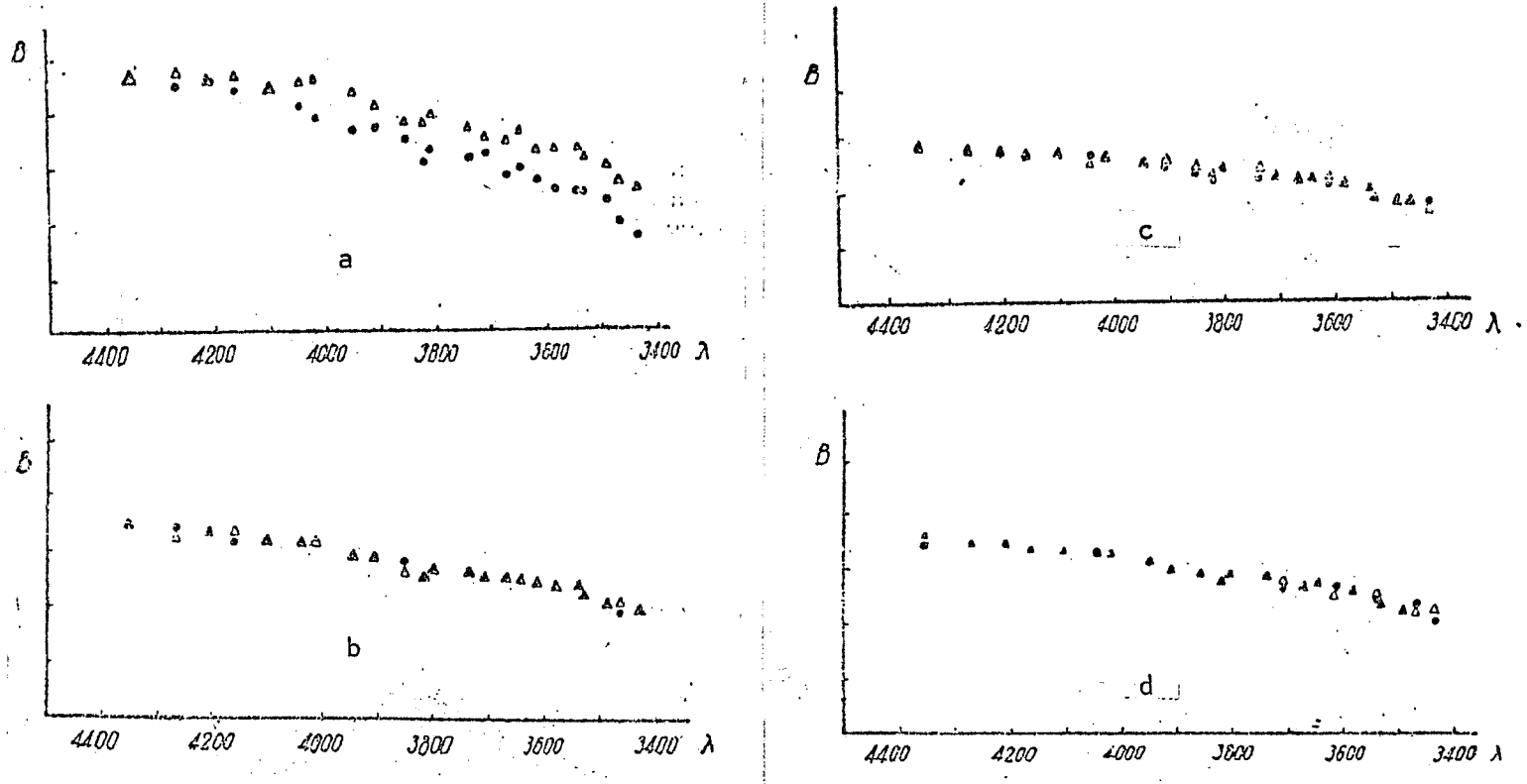

Figure 1. Relative Change in the Widths of the Spectrum of the Planet Jupiter. The dots represent a polar section and the x's (sic) represent an equatorial section: a, October 26, 1962; b, August 15, 1963; c, November 15, 1963; d, November 17, 1963.

An analysis of the curves shown (see Figure 1) allows us to make the following definite conclusion: the curve of 1962 for the polar diameter falls in the ultraviolet region significantly more steeply than for the equatorial diameter. At the same time in 1963, on dates when observations were conducted, no differences in the behavior of the curves for the equatorial and polar sections were detected. It should be noted that the curves of 1963 are "smoother" than the curves of 1962; no characteristic waves are observed.

A certain amount of interest is presented by the "averaged" curves for 1962 and 1963.

The construction of the curves presented in Figure 2 was accomplished in the following manner: the average spectral width values were taken for all sections for the equatorial and polar sections, or in other words, a unique, median curve was plotted which passes through the curves for the equatorial and polar diameter. The steep drop of the median curve of 1962 is quite noticeable in the drawing while the curves of August 15 and November 17, 1963, display a smooth motion with a certain insignificant difference.

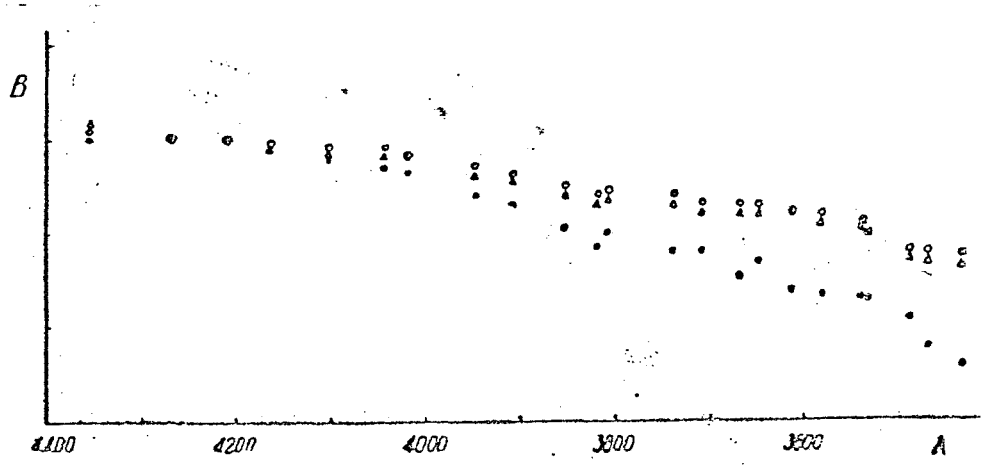

Figure 2. A Comparison of the Behavior of the Relative Change in the Width of the Spectrum. The dots indicate October 26, 1962; the x's (sic) indicate August 15, 1963 and the circles indicate November 17, 1963.

In October, 1962 and August, 1963 spectra were also obtained with the position of the spectrograph slit near the poles of Jupiter (the slit was situated parallel to the planetary equator); spectral width dependencies on λ were obtained which were similar to those already mentioned. As a result /45
of an analysis of the curves of 1962 and 1963, the following conclusions were made:

1. The curves of 1962 for the South and North Poles fall more steeply than the curves for the same poles in 1963 (see Figures 3a, 3b).

2. The curve of 1962 for the North Pole falls more steeply than the curve for the South Pole during the same year (see Figure 4a);

3. The curve for the North Pole in 1963 falls more steeply than the curve for the South Pole of the same year, but this effect is noticeably weakened in comparison with 1962 (see Figure 4b).

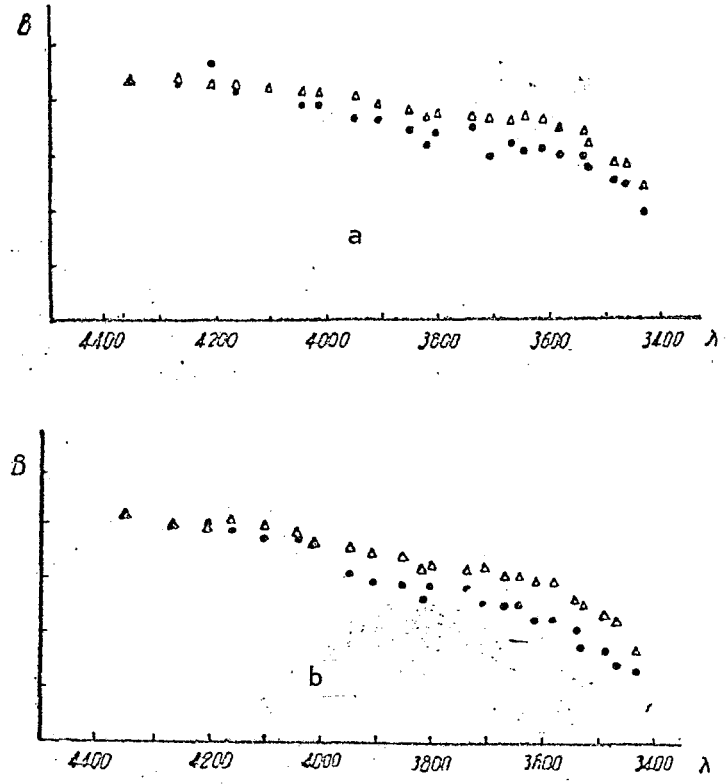

Figure 3. The Relative Change in the Width of the Spectrum for Like Poles of the Planet. The dots indicate October 26, 1962; the x's (sic) indicate August 15, 1963: a, North Pole; b, South Pole.

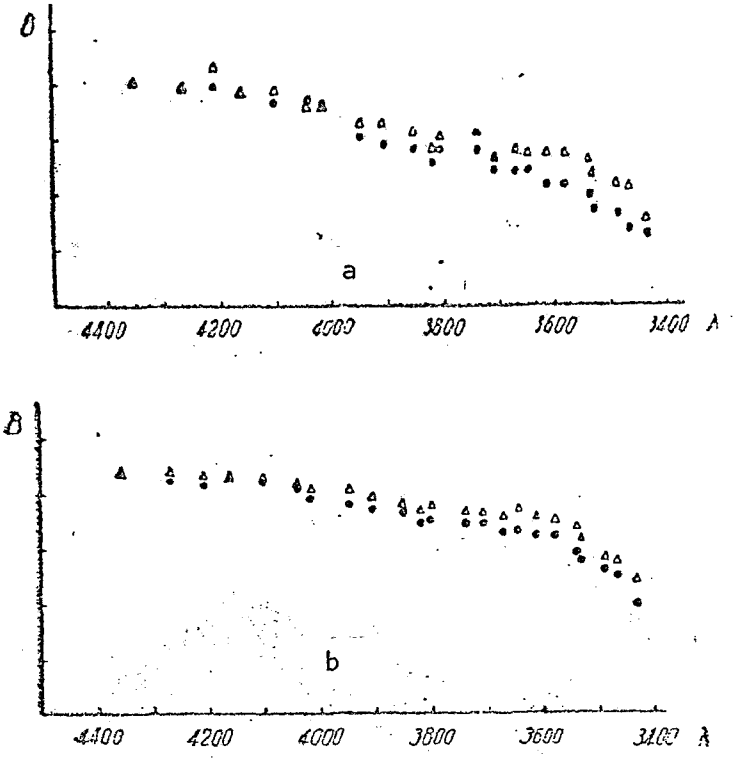

Figure 4. The Relative Change in the Width of Spectra For Unlike Poles of the Planet. The dots indicate the North Pole and the x's (sic) indicate the South Pole: a, October 26, 1962; b, August 15, 1963.

Figure 5 shows median curves plotted in accordance with the same principle as the curves shown in Figure 2. They demonstrate differences in the behavior of the relative change in the width of the spectrum near the poles in October, 1962 and in August, 1963.

An analysis of all of the observational material shows that the dependence of spectral width behavior on wavelength is not identical for different days of observations; the curves for the North and South Poles of Jupiter are not identical. A steeper variation is observed near the North Pole.

As is known, in October, 1962 the equatorial regions of the planet had a great deal of contrast, while during the days of observation in 1963 the degree of contrast of the equatorial zone was ordinary. Apparently the structure of the planetary atmosphere in the region of the poles and near

the equator changes rather significantly with time. It is probable that the activity of Jupiter also appears in the ultraviolet region of the spectrum. /46

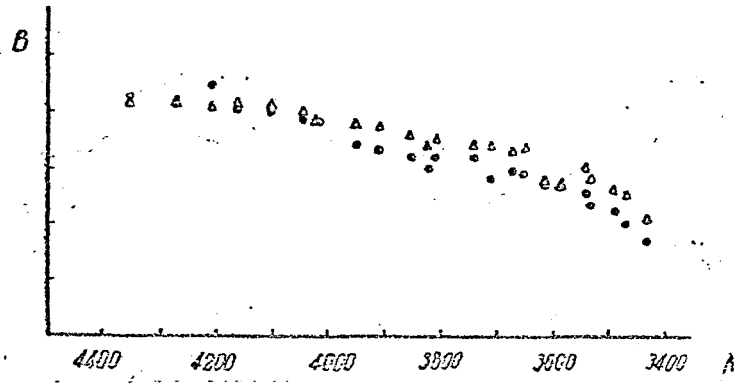

Figure 5. A Comparison of the Behavior of the Relative Change in Spectral Width Near the Planetary Poles: the dots indicate October 26, 1962; the x's (sic) indicate August 15, 1963.

The method described for the investigation of the Jovian atmosphere makes it possible to judge certain characteristics of the state of the planetary atmosphere and it may be employed as an inherent indicator for the rapid development of large-scale changes in the global nature of the state of the Jovian atmosphere.

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